SHORT TERM ANALYSIS OF FIXED BEARING TOTAL KNEE ARTHROPLASTY

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CERTIFICATE

*This is to certify that this dissertation entitled "***SHORT TERM ANALYSIS OF FIXED BEARING TOTAL KNEE ARTHROPLASTY**." *submitted by* ***Dr.R. RAJ GANESH*** *appearing for Part II, M.S. Branch II - Orthopaedics degree examination in March 2010 is a bonafide record of work done by him under my direct guidance and supervision in partial fulfilment of regulations of The Tamil Nadu Dr. M.G.R. Medical University, Chennai.*

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INTRODUCTION

Arthroplasty is an operation to restore pain-free motion of a joint and function of the muscles, ligaments, and other soft tissue structures that control the joint.

The goals of total joint arthroplasty are simple: to relieve pain, to provide motion while maintaining stability, and to correct deformity. Current total joint prostheses, properly implanted, consistently achieve exceedingly high success rates in meeting these goals in both short-term and long-term follow-up studies.

Total Knee Arthroplasty is the most commonly performed adult reconstructive knee procedure. Implanting femoral and tibial component to replace the degenerated knee joint will relieve the pain and provide mobile,pain free and a stable joint.

The primary indication for total knee arthroplasty is to relieve pain caused by severe arthritis, with or without significant deformity. Because knee replacement has a finite expected survival that is adversely affected by activity level, it generally is indicated in older patients with more sedentary lifestyles. It also is clearly indicated in younger patients who have limited function because of systemic arthritis with multiple joint involvement

The total condylar prosthesis was designed by Insall[1]. The design of the total condylar prosthesis included a chrome cobalt femoral component with a symmetrical anterior flange for patellar articulation. Most current total knee designs are derivatives of the Insall-Burstein and Kinematic designs.

Numerous studies have shown a correlation between success of total knee arthroplasty and restoration of near-normal limb alignment[2]. Malalignment of total knee prostheses has been implicated in few difficulties, including tibiofemoral instability, patellofemoral instability, patellar fracture, stiffness, accelerated polyethylene wear, and implant loosening. Accurate component placement in axial and rotational axis in knee replacement surgery is important .

Contraindications to total knee arthroplasty include recent or current knee sepsis, a remote source of ongoing infection, extensor mechanism discontinuity or severe dysfunction, recurvatum deformity secondary to muscular weakness, and the presence of a painless, well-functioning knee arthrodesis.

Results of Primary Total Knee Arthroplasty is assessed using the Knee Society knee score for functional assessment and the Total Knee Arthroplasty Roentgenographic Evaluation and Scoring System for radiological assessment.

Complications of Total knee Arthroplasty include deep vein thrombosis, infection instability, patellofemoral complications, neurovascular complications and periprosthetic fractures

We are presenting the short term follow up of functional results of Total knee arthroplasty prospectively done in our institute during the last 2 years.

HISTORICAL REVIEW

The first attempts to replace both femoral and tibial articular surfaces appeared in the 1950s as hinged implants with intramedullary stems developed by Walldius, Shiers, and others[3]. These simple hinged implants failed to account for the complex components of knee motion. This fact along with the deleterious nature of their metal-on-metal surface contact led to unacceptably high loosening rates with high rates of early and late infection. The Kinematic Rotating Hinge exemplifies the current status of truly linked hinged knee replacements. Two polyethylene and cobalt chrome bearings allow both flexion-extension and axial rotation.This type of prosthesis is used by some surgeons in patients with severe ligamentous insufficiency and in limb salvage procedures.

BICOMPARTMENTAL PROSTHESES

In 1971 Gunston[5] reported his early results with the polycentric knee. The geomedic knee arthroplasty was introduced in 1973 by Coventry et al[6] at the Mayo Clinic. The polyethylene tibial plateau component was one piece with an articular geometry that closely conformed to the femoral condyles in the sagittal plane for increased stability.

The Imperial College London Hospital (ICLH) design by Freeman and Swanson was developed as a "roller-in-trough" design with the one-piece femoral component constrained within the sagittally concave, one-piece tibial component by the existing tension of the capsule and the collateral ligaments. Both cruciate ligaments were routinely sacrificed. The tibial component had no intramedullary stem to minimize the consequences of possible infection and to maximize the potential for knee fusion as a salvage procedure. Tibial component loosening was subsequently its major shortcoming.

POLYETHYLENE INSERT

Ultrahigh molecular weight polyethylene (UHMWP) articular surfaces are an integral part of total knee replacement. Polyethylene wear and its consequences became dominant issues in total knee research in the 1990s[7].

Compared with the perfectly conforming articulations of total hip replacements, the tibiofemoral articulations in modern total knee replacements are nonconforming with the femoral condyles, having a decreasing radius of curvature posteriorly. PCL-retaining prostheses require an even greater degree of sagittal plane nonconformity because the tibial surface must remain relatively flat to allow femoral roll-back without excessive PCL tension[8].

TRICOMPARTMENTAL PROSTHESES

The total condylar prosthesis was designed by Insall and others at the Hospital for Special Surgery in 1973. Influenced largely by the previous ICLH design, both cruciate ligaments were sacrificed, with sagittal plane stability maintained by the articular surface geometry. The original cemented total condylar prosthesis dramatically reset the standard for survivorship of total knee replacements; Ranawat et al. reported a prosthetic survivorship of 94% at 15-year follow-up.

The design of the total condylar prosthesis included a chrome cobalt femoral component with a symmetrical anterior flange for patellar articulation. The symmetrical femoral condyles had a decreasing sagittal radius of curvature posteriorly and were individually convex in the coronal plane. The double-dished articular surface of the tibial polyethylene component was perfectly congruent with the femoral component in extension and congruent in the coronal plane in flexion. Translation and dislocation of the components were resisted by the anterior and posterior lips of the tibial component as well as the median eminence. The tibial component had a metaphyseal stem to resist tilting of the prosthesis during asymmetric loading. The tibial component was originally all-polyethylene, but metal backing was later added to allow more uniform stress transfer to the underlying cancellous metaphyseal bone and to prevent polyethylene deformation.

The patella was resurfaced with a dome-shaped, all polyethylene patellar component with a central fixation lug. Many of these design characteristics are retained in current designs.

Two of the early criticisms of the total condylar prosthesis were its tendency to subluxate posteriorly in flexion if the flexion gap was not balanced perfectly with the extension gap and a smaller range of flexion compared with prosthetic designs that allow femoral roll-back to occur. By not "rolling back," the posterior femoral metaphysis in a total condylar knee impinged against the tibial articular surface at approximately 95 degrees of flexion. The early clinical reviews of the total condylar prosthesis documented average flexion of only 90 to 100 degrees. To correct these problems, the Insall-Burstein posterior cruciate–substituting or posterior-stabilized design was developed in 1978 by adding a central cam mechanism to the articular surface geometry .The cam on the femoral component engages a central post on the tibial articular surface at approximately 70 degrees of flexion and causes the contact point of the femoral tibial articulation to be posteriorly displaced, thus effecting femoral roll-back and allowing further flexion.

Most current total knee designs are derivatives of the Insall-Burstein and Kinematic designs.

ANATOMY

The knee is the largest and more complex of the body.It is formed by fusion of the lateral femorotibial, medial femorotibial, and femoropatellar joints.The knee joint is formed by (1) the condyles of the femur, (2) the patella , and (3) the condyles of the tibia. The femoral condyles articulate with tibial condyles below and behind, and with the patella in front. It is compound synovial joint, incorporating two condylar joints between the condyles of the femur and tibia, and one saddle joint between the femur and the patella.

The fibrous capsule is very thin, and is deficient anteriorly, where it is replaced by the quadriceps femoris, the patella and the ligamentum patellae. Cruciate ligaments are very thick and strong fibrous bands, which act as direct bonds of union beween tibia and femur, to maintain anteroposterior stability of knee joint. They are named according to the attachment on tibia.The synovial membrane of the knee joint lines the capsule, except posteriorly where it is reflected forwards by the cruciate ligaments, forming a common covering for both the ligaments.

BLOOD SUPPLY OF KNEE JOINT

The knee joint is supplied by the anastomosis around it. The chief sources of blood supply are: (1) five genicular branches of the popliteal artery, (2) the descending genicular branch of the femoral artery, (3) the descending branch of the lateral circumflex femoral artery, (4) two recurrent branches of the anterior tibial artery, and (5) the circumflex fibular branch of the posterior tibial artery.

NERVE SUPPLY OF KNEE JOINT

1. femoral nerve, through its branches to the vasti, especially the vastus medialis. 2. sciatic nerve, through the genicular branches of the tibial and common peroneal nerves. 3. obturator nerve, through its posterior division.

MOVEMENTS OF KNEE

Movements at the knee joint Active movements at the knee are flexion, extension,medial rotation and lateral rotation. Flexion and extension are the chief movements. These take place in the upper compartment of the joint, above the menisci. They differ from the ordinary hinge movements in two ways, (1) the transverse axis around which these movements take place is not fixed. During, extension, the axis moves forwards and upwards, and in the reverse direction during flexion. (2) these movements are invariably accompanied by rotations or conjunct rotation. Rotatory movements at the knee are of a small range. Rotations take place around a vertical axis, and are permitted in the lower compartment of the joint, below the menisci. The conjunct rotations are of value in locking and unlocking of the knee Locking occurs as a result of medial rotation of the femur during the last stage of extension.

BIOMECHANICS

KINEMATICS

Knee motion during normal gait has been studied by many investigators who have found it to be much more complex than simple flexion and extension. Knee motion occurs in flexion and extension, abduction and adduction, and rotation about the long axis of the limb. Knee flexion, which occurs about a varying transverse axis, is a function of both the articular geometry of the knee and the ligamentous restraints. Failure to account for these complex knee motions and their attendant stresses was a shortcoming in many early knee prosthesis designs and probably is the main factor in the poor longevity of pure hinged prostheses. Many current prosthesis designs attempt to closely reproduce normal knee kinematics.

In kinematic studies of the knee during selected activities of daily living, Kettlekamp found that normal gait required 67 degrees of flexion during the swing phase, 83 degrees of flexion for stair climbing, 90 degrees for descending stairs, and 93 degrees to rise from a chair.

LONGITUDINAL AND ROTATIONAL ALIGNMENT OF KNEE

Numerous studies have shown a correlation between long-term success of total knee arthroplasty and restoration of near-normal limb alignment. Malalignment of total knee prostheses has been implicated in long-term difficulties, including tibiofemoral instability, patellofemoral instability, patellar fracture, stiffness, accelerated polyethylene wear, and implant loosening. The use of accurate instrumentation, as well as an understanding of the basic principles inherent to the instruments, is necessary to reproducibly implant well-aligned prostheses.

Normally, the anatomical axes of the femur and the tibia form a valgus angle of 6 degrees ± 2 degrees. The mechanical axis of the lower limb is defined as the line drawn on a standing long leg anteroposterior roentgenogram from the center of the femoral head to the center of the talar dome.This mechanical axis typically should project through the center of the knee joint, described as a "neutral" mechanical axis. During normal gait the mechanical axis is inclined 3 degrees from the vertical axis of the body, with the feet closer to the midline than the hips. When the mechanical axis lies to the lateral side of the knee center, the knee is in mechanical valgus alignment. In mechanical varus alignment, the mechanical axis of the limb lies to the medial side of the knee center. The amount of varus or valgus deformity can be determined on the anteroposterior roentgenogram by first drawing the mechanical axis of the femur, a line from the center of the femoral head to the center of the intercondylar notch, and extending this line distally. The mechanical axis of the tibia runs from the center of the tibial plateau to the center of the tibial plafond, thus accounting for any bowing of the tibia. The angle formed between these separate mechanical axes of the femur and tibia determines the varus or valgus deviation from the neutral mechanical axis. By determining the tibial mechanical axis using the center of the tibial plateau and the femoral mechanical axis using the center of the intercondylar notch, any medial or lateral subluxation through the knee joint is disregarded. Insall has argued that rotation affects the mechanical axis of the femur apparent on an anteroposterior roentgenogram, thus lessening the value of these preoperative measurements.

In a normal knee, the tibial articular surface is in approximately 3 degrees of varus with respect to the mechanical axis, and the femoral articular surface is in a corresponding 9 degrees of valgus. Multiple studies, including those by Tew and Waugh[9], Jeffery, Morris and Denham[10], and others, demonstrated that tibial components placed in more than 5 degrees of varus tend to fail by subsiding into more varus. Consequently, tibial components generally are implanted perpendicular to the mechanical axis of the tibia in the coronal plane, with varying amounts of posterior tilt in the sagittal plane, depending on the articular design of the component to be implanted. The femoral component usually is implanted in 5 to 6 degrees of valgus, the amount necessary to reestablish a neutral mechanical axis of the limb.

Rotational alignment of total knee components is difficult to discern roentgenographically, making the assessment of rotation primarily an intraoperative determination. The rotation of the femoral component has effects not only on the flexion space but also on the patellofemoral tracking. Because the proximal tibial cut is made perpendicular to the mechanical axis of the limb instead of in the anatomically correct 3 degrees of varus, rotation of the femoral component also must be altered from its anatomical position to create a symmetrical flexion space. To create this rectangular flexion space, with equal tension on the medial and lateral collateral ligaments, the femoral component usually is externally rotated approximately 3 degrees relative to the posterior condylar axis. In a normal femur, this technique rotationally places the femoral component with the posterior condylar surfaces parallel to the epicondylar axis. This technique fails when the posterior aspect of either the native femoral condyle has significant wear or when the lateral femoral condyle is hypoplastic, as is frequently seen in knees with valgus deformity. In these instances, the surgeon can rely on palpation of the epicondylar axis or the anteroposterior axis popularized by Whiteside. Each of these techniques of determining femoral component rotation is based on the geometry of the femur primarily, with subsequent ligamentous releases to create symmetrical flexion and extension gaps. The older gap technique of performing cuts and the rotational alignment based on creating a symmetrical flexion space in the partially released knee frequently created rotational malalignments of the femoral component with regard to the epicondylar axis and the patellofemoral joint.

Notably, some prostheses have been developed that include external rotation of the femoral component by incorporating a thicker lateral posterior femoral condyle in combination with a thinner medial posterior femoral condyle. Reis et al[11] argued that external rotation of the femoral component lateralizes the trochlea in extension yet medializes it in flexion past 90 degrees. They emphasized deepening the trochlea with lateralization of only the proximal end of the trochlea. Kaper, Woolfrey, and Bourne[12] noted that the Genesis II prosthesis of this design had a lower rate of lateral retinacular release compared with the more traditional Genesis I design.

IMPLANT DESIGN

The design of the total condylar prosthesis included a chrome cobalt femoral component with a symmetrical anterior flange for patellar articulation. The symmetrical femoral condyles had a decreasing sagittal radius of curvature posteriorly and were individually convex in the coronal plane. The double-dished articular surface of the tibial polyethylene component[13] was perfectly congruent with the femoral component in extension and congruent in the coronal plane in flexion. Translation and dislocation of the components were resisted by the anterior and posterior lips of the tibial component as well as the median eminence. The tibial component had a metaphyseal stem to resist tilting of the prosthesis during asymmetric loading. The tibial component was originally all-polyethylene, but metal backing was later added to allow more uniform stress transfer to the underlying cancellous metaphyseal bone and to prevent polyethylene deformation.

POLYETHYLENE ISSUES

Ultrahigh molecular weight polyethylene (UHMWP) articular surfaces are an integral part of total knee replacement.Catastrophic wear leading to early failure and osteolysis, although seen less frequently than in total hip arthroplasty, has occurred more frequently in some total knee designs. The study of polyethylene has provided information on its varying wear characteristics after different fabrication and sterilization processes, as well as its limitations in total knee applications.

Compared with the perfectly conforming articulations of total hip replacements, the tibiofemoral articulations in modern total knee replacements are nonconforming with the femoral condyles, having a decreasing radius of curvature posteriorly. PCL-retaining prostheses require an even greater degree of sagittal plane nonconformity because the tibial surface must remain relatively flat to allow femoral roll-back without excessive PCL tension. This nonconformity creates areas of high contact stress within the polyethylene[14].

Tibial polyethylene thickness also is correlated with accelerated wear[8]. Bartel, Bicknell, and Wright[7] recommended a minimal polyethylene thickness of 8 mm to avoid the higher contact stresses that occur with thinner polyethylene. Collier et al.[15] also recommended a minimal 8-mm thickness on the basis of finite element modeling. Retrieval studies demonstrating accelerated wear in knees implanted with thin polyethylene have validated this recommendation.

The introduction of highly cross-linked polyethylene produced by high-dose gamma irradiation with subsequent annealing has produced dramatic decreases in wear in simulated hip studies[16].

COMPONENT FIXATION

Prosthetic fixation with polymethylmethacrylate (PMMA) in total knee replacement gained widespread use in the 1970s and has continued through the present cemented fixation has produced more uniformly reliable long-term fixation with less osteolysis in multiple prosthesis designs[17].

ROLE OF PCL IN TOTAL KNEE ARTHROPLASTY

Since the concurrent development of PCL-retaining and PCL-substituting prostheses, the relative merits of each design have been debated. The first argument in favor of PCL retention is a greater potential range of motion with effective femoral roll-back and a relatively flat tibial articular surface.However, in multiple studies comparing PCL-retaining and PCL-substituting prostheses, the average flexion attained at long-term follow-up has been similar. When the PCL is retained, authors have emphasized that it may need to be recessed to allow adequate flexion. More contemporary deep-dish designs with increased sagittal plane conformity have been studied by Scott and Thornhill[18] with PCL recession and by Laskin et al. and Hofmann et al[13] with PCL sacrifice. The flexion in these more contemporary conforming devices is similar to the PCL-retaining and PCL-substituting devices with which they have been compared.

FIXED BEARING AND ROTATING PLATFORM INSERT

The polyethylene insert in a total knee replacement (TKR) can be fixed to the tibial plateau or it can have freedom of rotation and / or translation. It is not yet clear whether there are differences in functional or clinical results between the two prosthesis types.

For articular surface wear, there was no statistical difference between pitting and scratching, but burnishing was twice as much for MB inserts[19]. For backside scores, there was a minimal amount of pitting for both, but the scratching score was twice and the burnishing score was 3 times greater for MB inserts.At more than 5 years in situ, the linear wear measurements were similar for the 2 groups (mean penetration was 0.329 mm for MB and 0.320 mm for fixed bearing)[20].

INDICATIONS FOR TOTAL KNEE ARTHROPLASTY

The primary indication for total knee arthroplasty is to relieve pain caused by severe arthritis, with or without significant deformity. Patients who do not have complete cartilage space loss before surgery tend to be less satisfied with their clinical result after total knee arthroplasty. Before surgery is considered, conservative treatment measures should be exhausted, including antiinflammatory medications and activity modifications

Because knee replacement has a finite expected survival,it generally is indicated in older patients with more sedentary lifestyles[21]. It also is clearly indicated in younger patients who have limited function because of systemic arthritis with multiple joint involvement.

The common indications being

- Osteoarthritis
- Rheumatoid Arthritis
- Juvenile Rheumatoid Arthritis
- Posttraumatic Arthritis
- Osteonecrosis
- Haemophilic Arthritis
- Gouty Arthritis
- Other Inflammatory Arthritis

- Malalignment of Knee joint(knock Knees or Bow Legs)
- Dysplasias

CONTRAINDICATIONS FOR TOTAL KNEE ARTHROPLASTY

Contraindications to total knee arthroplasty include :

- recent or current knee sepsis.
- extensor mechanism discontinuity or severe dysfunction.
- recurvatum deformity secondary to muscular weakness.
- presence of a painless, well-functioning knee arthrodesis.

Relative contraindications are numerous and debatable.

- medical conditions that compromise the patient's ability to withstand anesthesia.
- significant atherosclerotic disease of the operative leg.
- skin conditions such as psoriasis within the operative field.
- neuropathic arthropathy.
- morbid obesity.
- recurrent urinary tract infections.
- History of osteomyelitis in the proximity of the knee.

This list is not all-inclusive, and any preoperative condition that can adversely affect the patient's outcome can be considered a relative contraindication.

COMPLICATIONS OF TOTAL KNEE ARTHROPLASTY

THROMBOEMBOLISM

One of the most significant complications after total knee arthroplasty is the development of deep venous thrombosis (DVT), possibly resulting in life-threatening pulmonary embolism (PE). Factors that have been correlated with an increased risk of DVT include age over 40 years, estrogen use, stroke, nephrotic syndrome, cancer, prolonged immobility, previous thromboembolism, congestive heart failure, indwelling femoral vein catheter, inflammatory bowel disease, obesity, varicose veins, smoking, hypertension, diabetes mellitus, and myocardial infarction. The overall prevalence of DVT after TKA without any form of mechanical or pharmaceutical prophylaxis has been reported to range from 40% to 84%.Thrombi in the calf veins do have a propensity to propagate proximally, as documented in 6% to 23% of patients[22]. The risk of asymptomatic PE may be as high as 10% to 20%, with symptomatic PE reported in 0.5% to 3% of patients and a mortality rate of up to 2%.

Low-molecular-weight heparin (LMWH) has been shown to be effective in DVT prophylaxis after TKA. In studies comparing LMWH and warfarin TKA patients, a reduction in overall DVT rates for LMWH of 33% from 47% for warfarin has been reported.[23]

INFECTION

Infection remains one of the most dreaded complications affecting TKA patients. Large series reported by Hanssen and Rand[24], Salvati et al.[25], and Wilson, Kelley, and Thornhill[26] showed incidences of 2.5% in 18,749 TKAs, 2.6% in 886, and 1.6% in 4171, respectively. Preoperative factors associated with a higher rate of infection after TKA include rheumatoid arthritis (especially in seropositive males), skin ulceration, previous knee surgery, use of a hinged-knee prosthesis, obesity, concomitant urinary tract infection, steroid use, renal failure, diabetes mellitus, poor nutrition, malignancy, and psoriasis.

PATELLOFEMORAL COMPLICATIONS

Patellofemoral complications, including patellofemoral instability[27], patellar fracture, patellar component failure, patellar component loosening, patellar clunk syndrome, and extensor mechanism tendon rupture, have been cited as the most common reasons for reoperation. This has led many authors to advocate TKA without patellar resurfacing for patients with osteoarthritis and adequate patellar cartilage.

PERIPROSTHETIC FRACTURES

Supracondylar fractures of the femur occur infrequently after TKA (0.3% to 2%). Reported risk factors include anterior femoral notching[28], osteoporosis, rheumatoid arthritis, steroid use, female gender, revision arthroplasty, and neurological disorders.

The anterior femoral flange of condylar-type prostheses creates a stress riser at its proximal junction with the relatively weak supracondylar bone.

NEUROVASCULAR COMPLICATIONS

Arterial compromise after TKA is a rare but devastating complication that occurs in 0.03% to 0.2% of patients, with up to 25% resulting in amputation. The circulatory status of the limb should be examined carefully in all patients before operation. Noninvasive vascular studies are indicated in patients with questionable vascular supply. Several authors have recommended performing TKA without the use of a tourniquet in patients with significant vascular disease[30].

Peroneal nerve palsy is the only commonly reported nerve palsy after TKA[29]. It occurs primarily with correction of combined fixed valgus and flexion deformities, as are common in patients with rheumatoid arthritis. The prevalence of peroneal nerve palsy in the Swedish Knee Arthroplasty project was 1.8% in 2273 rheumatoid patients and 0.3% of 10,361 in the Mayo Clinic series.

AIM

The aim of this study is to analyse the short term follow up of functional and radiological results of twenty cases of Fixed bearing Total Knee Arthroplasty prospectively done in our institute during the period April 2008 to September 2009.

PROCEDURE

PREOPERATIVE EVALUATION

A detailed preoperative medical evaluation of the patients for comorbid diseases were done. Patient's cardiopulmonary reserve to withstand anesthesia, either general or epidural was assessed. A routine preoperative cardiac evaluation done , and those patients who have a history of coronary artery disease, mild congestive heart failure, chronic obstructive pulmonary disease (COPD), or restrictive pulmonary disease were evaluated by appropriate medical consultants. Vascular supply to the operative leg was also evaluated.

Routine preoperative laboratory evaluation including complete blood cell count, electrolytes, urinalysis and chest roentgenogram was done. Similarly preoperative evaluation of coagulation studies done in patients with a history of bleeding or coagulopathy. Patients receiving anticoagulant medications were managed appropriately to limit blood loss while ensuring medical stability in the perioperative period.

Urine culture and throat swab culture were done to rule out focal sepsis

PREOPERATIVE RADIOLOGICAL EVALUATION

Preoperative knee roentgenograms including a standing anteroposterior view, a lateral view and a long leg standing AP view was taken . The long leg standing anteroposterior view is beneficial in determining the mechanical axis of the limb and is also useful to determine any significant bowing of the tibia or femur. Templates are used to anticipate approximate component size and bone defects that will need to be treated intraoperatively.

The goal of preoperative radiological evaluation is to confirm the diagnosis leading to surgical intervention,to determine the anatomical relationship of the femur and tibia,and to allow for accurate restoration of joint anatomy and biomechanics.

PREOPERATIVE CT OF DISTAL FEMUR

Survivorship of TKA is directly related to appropriate alignment and balance. Surgeons should evaluate the biomechanics of knee alignment and determine the proper position of the implant. Quite a number of reference parameters have been suggested to get proper rotational alignment of femoral component.They are

1.Transepicondylar line.

2.Whiteside's line.

3.Posterior condylar line of femur.

These axes are assessed preoperatively by taking CT scan of distal femur(cross sectional cuts at regular distance from joint).The difference in angle between the posterior condylar line and the transepicondylar line is calculated which gives the angle of posterior condylar cut during surgery to place it parallel to epicondylar axis.

ROTATIONAL ALIGNMENT

The rotation of the femoral component has effects not only on the flexion space but also on the patellofemoral tracking. Because the proximal tibial cut is made perpendicular to the mechanical axis of the limb instead of in the anatomically correct 3 degrees of varus, rotation of the femoral component also must be altered from its anatomical position to create a symmetrical flexion space. To create this rectangular flexion space, with equal tension on the medial and lateral collateral ligaments, the femoral component usually is externally rotated approximately 3 degrees relative to the posterior condylar axis.

In a normal femur, this technique rotationally places the femoral component with the posterior condylar surfaces parallel to the epicondylar axis. This technique fails when the posterior aspect of either the native femoral condyle has significant wear or when the lateral femoral condyle is hypoplastic, as is frequently seen in knees with valgus deformity.

In these instances, the surgeon can rely on palpation of the epicondylar axis or the anteroposterior axis popularized by Whiteside.Each of these techniques of determining femoral component rotation is based on the geometry of the femur primarily, with subsequent ligamentous releases to create symmetrical flexion and extension gaps.

SCORING :- Preoperatively all patients are functionally evaluated using Knee society knee score.The Knee Society clinical rating system has a separate knee score with 50 points for pain, 25 points for range of motion, and 25 points for stability. Points are deducted for flexion contracture, extension lag, and malalignment.

Pain	Points
None	50
Mild or occasional	45
Stairs only	40
Walking and stairs	30
Moderate	
Occasional	20
Continual	10
Severe	0
Range of Motion	
(5° = 1 point)	25
Stability (maximal movement in any position)	
Anteroposterior	
<5 mm	10
5-10 mm	5
10 mm	0
Mediolateral	
<5°	15
6°-9°	10
10°-14°	5
15°	0
Subtotal	____
Deductions (minus)	
Flexion contracture	
5°-10°	2
10°-15°	5
16°-20°	10
>20°	15
Extension lag	
<10°	5
10°-20°	10
>20°	15
Alignment	
5°-10°	0
0°-4°	3 points each degree
11°-15°	3 points each degree
Other	20
Total deductions	____
Knee score	____
(If total is a minus number, score is 0.)	

SURGICAL PROCEDURE

We used Depuy PFC fixed bearing knee in 17 patients, Stryker knee in 2 patients and Indus knee in 1 patient.

Preparation of the patient

On the day of surgery,the skin is prepared using povidone iodine solution and covered with sterile clothes and brought to the theatre where final preparation is done.Prophylactic antibiotics are given just before skin incision.

Operation theatre

The surgery is done in theatre with laminar air flow to reduce exogenous bacterial contamination.Adequate precautions are taken to maintain sterility like thorough fumigation,air conditioning,limiting the traffic in theatre.

Approach

We used the anterior midline incision for skin and a medial parapatellar retinacular approach for the retinaculum. The retinacular incision is extended proximally the length of the quadriceps tendon, leaving a 3- to 4-mm cuff of tendon on the vastus medialis for later closure. The incision is continued around the medial side of the patella, extending 3 to 4 cm onto the anteromedial surface of the tibia along the border of the patellar tendon. The medial side of the knee is exposed by subperiosteally stripping the anteromedial capsule and deep medial collateral ligament off the tibia to the posteromedial corner of the knee

The knee is extended and the patella is everted along with routine release of lateral patellofemoral plicae. The knee is again flexed, the anterior cruciate ligament and the anterior horns of the medial and lateral menisci are removed along with any osteophytes that may lead to component malposition or soft tissue imbalance. The posterior horns of the menisci can be excised after the femoral and tibial cuts have been made.The PCL can be resected at this time or can be removed later in the procedure with the box cut made in the distal femur for the PCL-substituting femoral component.The tibia can now be subluxated anteriorly and externally rotated. External rotation relaxes the extensor mechanism, decreases the chance of patellar tendon avulsion, and improves exposure. The lateral tibial plateau is exposed by a partial excision of the patellar fat pad and retraction of the everted extensor mechanism with a levering-type retractor placed carefully adjacent to the lateral tibial plateau.

TIBIAL PREPARATION

The instruments for the tibial preparation we used are based upon extramedullary referencing. Because the anterior prominence of the tibial shaft and the malleoli of the ankle joint are usually readily palpable, extramedullary rods for the tibia are very reliable.

The initial tibial cut is usually perpendicular to the shaft with a slight posterior angulation according to the system that is being used.Tibial stem preparation is done.

FEMORAL PREPARATION

Femoral preparation is done using intramedullary alignment jig. Make the distal femoral cut at a valgus angle perpendicular to the predetermined mechanical axis of the femur and the desired mechanical axis of the limb. The amount of bone removed generally is the same as that to be replaced by the femoral component. The anterior and posterior femoral cuts determine the rotation of the femoral component and thus the shape of the flexion gap.

Femoral component rotation can be determined by one of several methods. The transepicondylar axis, anteroposterior axis, posterior femoral condyles, and the cut surface of the proximal tibia can all serve as reference points.We used the transepicondylar axis, making the posterior femoral cut parallel to a line drawn between the medial and lateral femoral epicondyles.The preoperative CT angle was considered during posterior condylar cut.

Complete the distal femoral preparation for by making anterior and posterior chamfer cuts for the implant. Remove the intercondylar "box" to accommodate the housing for the post and cam mechanism.

LIGAMENTOUS BALANCING

Balance of the flexion and extension gaps done by placing spacer blocks or a tensioner within the gaps with the knee in both flexion and extension. Varus-valgus balance can be fine tuned with further medial or lateral releases.Remove any medial or lateral osteophytes that tent the collateral ligaments. Remove posterior condylar osteophytes with a curved osteotome because they can tent the posterior capsule and narrow the extension gap or impinge during knee flexion. The flexion and extension gaps must be roughly equal. If the extension gap is too small or tight, extension will be limited. Similarly, if the flexion gap is too tight, flexion will be limited. Laxity of either gap can lead to instability. If the extension gap is smaller than the flexion gap, remove more bone from the distal femoral cut surface or release the posterior capsule from the distal femur. If the flexion gap is smaller than the extension gap, remove more bone from the posterior femoral condyles by making appropriate cuts for the next smaller available femoral component. If the flexion and extension gaps are equal, but there is not enough space for the desired prosthesis, remove more bone from the proximal tibia, because bone removed from the tibia affects the flexion and extension gaps equally. When the flexion and extension gaps are equal but lax, a larger spacer block and a larger tibial polyethylene insert are required to obtain stability.

COMPONENT IMPLANTATION

After bone deficiencies have been treated, ligamentous balancing is satisfactory, and the extensor mechanism is tracking properly, the trial components are removedThe cut bone surfaces are cleaned with a pulsatile lavage irrigator using saline.The surfaces are then dried with clean sponges. The tibial tray is implanted first. Doughy PMMA cement is applied to the cut surface of the tibia.Excess cement is removed from the periphery of the component.

The femoral components is cemented in a similar fashion with a few additional considerations. Usually, all components are cemented simultaneously with one batch (80 g) of cement.

The retinacular incision is closed with absorbable suture, taking great care to close the elevated periosteal tissues to the patellar tendon. The knee should be flexed past 90 degrees to ensure that no part of the closure limits flexion and that the patella tracks normally. The subcutaneous tissue and skin are closed with the knee in 30 to 40 degrees of flexion to aid in skin flap alignment.

POST OPERATIVE PROTOCOL

Knee immobilizer and compression bandage are applied postoperatively.Ankle and toe movements are encouraged from day one.Epidural analgesia is administered for 48 hrs. Drain removal done after 24-48 hrs .Intravenous antibiotics are given for 5 days.Low molecular weight heparin is administered for 10 days.

Physiotherapy is started from first day.Static gluteal and quadriceps exercises are taught. Passive and active knee mobilization is started after drain removal.The patient is made to sit up in bed and also with legs hanging by the side of the bed.Weight bearing with crutch support is allowed with knee in an immobilizer after drain removal.

Patient continues supervised physiotherapy till discharge.

FOLLOW UP

The patient reports for follow up at 3 weeks and 6 weeks.At this time patient is self ambulatory without any support.The patients were called back for review at 3 months interval.At the end of this study,they were evaluated with Knee society scores.

X rays of knee in anteroposterior,lateral and long leg weight bearing views were taken and the alignment of component evaluated.Follow up X rays were taken to evaluate loosening,bone resorption and any implant failure.

CT of the distal femur is taken during follow up and the rotational orientation of the epicondylar line with posterior aspect of femoral component is evaluated.

The duration of follow up at the end of this study ranged from 22 weeks to 56 weeks.

MATERIALS AND METHODS

This is a prospective study conducted at the Department of Orthopaedic surgery,Government General Hospital from April 2008 to September 2009.Out of the 25 cases of Total knee Arthroplasty done in our department during this period,We selected 20 Total Knee Arthroplasty which fulfilled the selection criteria for our study .

The age range was 32 to 65 years. There were 5 male patients and 15 female patients.The diagnosis leading to surgery was Osteoarthritis in 13 cases and Rheumatoid arthritis in 7 cases.

The inclusion criteria were :-

1. Bicompartmental Arthritis of knee – OA, R.A, Post trauma.
2. Neutral,Varus,Valgus and Flexion deformity<30°

The exclusion criteria were :-

1. Patients who lost followup
2. Flexion deformity > 30°

In the study period 28 knees were operated in 20 patients.The age range was 32 to 65 years,average 48.5 years. There were 5 male patients and 15 female patients.The diagnosis leading to surgery was Osteoarthritis in 13 cases and Rheumatoid arthritis in 7 cases.Out of the 28 knees 5 were in neutral ,11 in varus , 2 in valgus , 2 in flexion , 2 in valgus and flexion and 6 were in varus and flexion.

SEX RATIO

Sex	No. of Patients	Percentage
Male	5	25
Female	15	75

AGE INCIDENCE

Age	No. of Patients	Percentage
30 - 50	7	35
51 - 70	13	65

SIDE INVOLVED

Side	No. of Cases	Percantage
Right	6	30
Left	6	30
Bilateral	8	40

INDICATION FOR SURGERY

Indication	No.of Patients	Percentage
Osteoarthritis	14	70
Rheumatoid	6	30

ALIGNMENT

Alignment	No. of Knees	Percentage
Varus	11	39.3
Neutral	5	17.8
Valgus	2	7.1
flexion	2	7.1
Varus and flexion	6	21.6
Valgus and flexion	2	7.1

PRE-OP RADIOLOGICAL ASSESSMENT

Angle	Range	Average
Lateral distal femoral angle	80 - 92	84.06
Medial proximal tibial angle	75 - 88	82.4
Tibial slope	4 - 14	7
Transepicondylar line-Posterior condylar line angle	2° - 7°	4.82°

The average follow up was 40 weeks (range 12 to 64 weeks).

All patients were evaluated clinically and radiologically preoperatively and at various follow up periods.All patients were analysed using Knee society Knee Score.

OBSERVATION AND RESULTS

In our study we have analysed the functional results of fixed bearing Total Knee Arthroplasty, done in 20 patients in the Government General Hospital during the period april 2008 to august 2009. Eight patients in this series had bilateral TKA.

The range of motion was

Range	Preoperative	Postoperative
Flexion	105.2	110.6

The average postoperative flexion in the rheumatoid group was 105.4 degrees and in the osteoarthritis group was 115.8 degrees

There was no incidence periprosthetic fractures.No patients had neurological deficit or dislocations.

One case had valgus instability postoperatively.

In our study all our patients showed an improvement in knee score.

Scoring system	Preoperative	Postoperative
Knee society score	50.4(46-57)	75.6(65-88)

2 patients had excellent score(80-100).16 patients had good score(70-79) and 2 patients had fair results(60-69).

The mean increase in Knee score was 34.2 .In the osteoarthritis group it was 34 and in rheumatoid group it was 35.8.

RADIOLOGICAL RESULTS

COMPONENT POSITIONING

The accuracy of component position was assessed by mechanical axis restoration,coronal tibio femoral angle,sagittal femoral angle,posterior tibial slope by X-ray and the transepicondylar line-posterior condyle component angle by CT.

Mechanical axis restoration

The mechanical axis restoration after surgery was assessed using long leg X ray of the operated limb.The tibial component is divided into 5 zones and the zone in which mechanical axis intersects is noted as shown in the picture

Out of the 28 knees operated 12 knees had alignment to the centre zone, 2 had alignment in zone 1,12 had alignment in zone 2 and 2 had alignment in zone 3.

Component position

The angle between the transepicodylar line and the posterior condyle of the component (internal rotation of the femoral component) was measured using post op CT of distal femur.The average was 1.28 degree.

Component position and functional outcome

The patients with ideal placement of the components i.e with mechanical axis in zone C&2 and the rotational alignment accurate(Transepicondylar-Posterior condyle component angle- 0 and 1 degree) were assessed for knee flexion and knee score

No. of Knees :- 10

Postop knee flexion :- average 113.5 deg

Knee score :- average 78.5

This shows an increase in knee flexion of 3.5 degrees and knee score of 3 in this group of patients from the general group.

Rotational alignment of distal femur

In 6 knees the femoral component was externally rotated peroperatively as per the predetermined angle in CT of distal femur(cases 1,2,3,13,17,18 in Master chart). The post op CT of distal femur and functional results in these patients are assessed.

Transepicondylar / posterior condyle component angle :- 0.33 average

Post operative Knee society score :- 79.3 average

Post operative knee flexion :- 111.6

This shows an increase in knee flexion of 1 degree and an increase in Knee score of 3.7 . The femoral component internal rotation is 0.33 compared to the general average of 1.28

PATELLAR TRACKING

No patients had maltracking of patella clinically.one patient with anterior knee pain and two patients with limited flexion post operatively were evaluated with axial view of knee. There were no evidence of patellar tilt or subluxation.

RADIOLUCENCY

No patients had loosening and osteolysis noted around the femoral and tibial components.This was not significant because our study is a short term study.

IMPLANT SURVIVAL

No implant needed to be revised during the period of study.There was no incidence of superficial or deep infection.

FUNCTIONAL RESULTS

Of the 20 patients 18 cases returned to their premorbid condition.Two patients who where rheumatoid has persistent pain.

CASE 1

A 45 year old female patient (case 1 in master chart) presented with osteoarthritis left knee.Her preoperative knee score was 55.She underwent left sided TKA on 10.02.09.She had uneventful recovery and had knee score of 86 at 8 month follow up.The results were graded as excellent.

CASE 2

A 36 year old female patient (case 2 in master chart) presented with Rheumatoid arthritis both knee.Her preoperative knee score was 46.She underwent single stage bilateral TKA on 6.02.09. She had uneventful recovery and had knee score of 78 at 8 month follow up.The results were graded as good.

CASE 3

A 33 year old female patient (case 3 in master chart) presented with Rheumatoid arthritis both knee.Her preoperative knee score was 47.She underwent single stage bilateral TKA on 19.03.09. She had uneventful recovery and had knee score of 76 at 8 month follow up.The results were graded as good.

CASE 4

A 58 year old female patient (case 1 in master chart) presented with osteoarthritis left knee.She had her right knee operated 1 year back.Her preoperative knee score was 54.She underwent bilateral TKA on 13.07.08. She had uneventful recovery and had knee score of 82 at 12 month follow up.The results were graded as excellent.

DISCUSSION

Total knee arthroplasty has had a renaissance in the last decade. The total condylar prosthesis was designed by Insall and others at the Hospital for Special Surgery in 1973. This prosthesis followed the philosophy that mechanical considerations should outweigh the desire to anatomically reproduce the kinematics of normal knee motion. Both cruciate ligaments were sacrificed, with sagittal plane stability maintained by the articular surface geometry. The original cemented total condylar prosthesis dramatically reset the standard for survivorship of total knee replacements; Ranawat et al. reported a prosthetic survivorship of 94% at 15-year follow-up.

The evolutions on the designs of prosthesis resulted in posterior cruciate retaining prosthesis and the rotating platform prosthesis.The rotating platform prosthesis has a polythene insert which is capable of a rotatory movement within the tibial component during movements of knee.They have a claimed benefit of better patellofemoral tracking and better function.We in our study used the fixed bearing prosthesis as is done in our institution.

Since the tibial component is fixed,the rotational placement of femoral component is important.Our study included this aspect and we measured the angle between epicondylar line and posterior condylar line for aiding intraoperative placement of the femoral component in correct rotational alignment.

We have assessed the radiological and clinical outcome after the procedure.Radiological outcome was assessed by taking preoperative and postoperative long leg X-rays and CT of the distal femur and measuring the alignment of the prosthesis axially and rotationally.Clinical outcome was measured by preoperative and postoperative knee society scores.

CLINICAL PROFILE

The mean age of the patients was 48.5 years.The study group included 15 female patients and 5 male patients.Bilateral total knee replacement was performed in 8 cases.The study group included 10 knees with combined deformity,11 knees in varus,5 knees in neutral and 2 knees with valgus deformity.Out of the 20, 6 patints were diagnosed as rheumatoid and 14 patients were osteoarthritis.

Some conventional fixed-bearing TKAs have been proved to be clinically successful. Survivorship of the Genesis (Smith and Nephew, Memphis, TN) TKA was 96% at 10 years follow-up[31]. Ritter et al reported a survivorship of 98.8% at 15 years[32] with the Anatomic Graduated Components (Biomet, Warsaw, IN) TKA. The survival rate of the Total Condyle knee prostheses (Howmedica, Rutherford, JN) was 95% at 15 years[33], 98% at 20 years and 91% at 23 years in different studies[34].

Since our study was short term,**we observed a 100 percent survival rate.**

There is a debate about the range of motion achieved with Total knee arthroplasty.In one report by Wyled et al (2008) the mean flexion range was 112.8° in 142 cases of fixed bearing knees[35].Study in fixed bearing knee in Indian population by Attique Vasdev reported 101° ± 7.8° in 60 patients[36].

The mean range of flexion in our study is 110.6° .The average postoperative flexion in the rheumatoid group was 105.4 degrees and in the osteoarthritis group was 115.8 degrees.

Functional analysis was done by Knee society knee score[37].Reported results in *The Knee* by J. Lim, K. Luscombe, P. Jones, S. White[38] showed a postoperative mean KSS was 86.7 and mean function score was 85.0.Study conducted in Orthopaedic and Trauma Clinic, Kaunas Medical University reported significant improvement in quality of life and a better Knee Society score[39].

In our study we observed that the return to function is excellent to good at short term follow up. 2 patients had excellent score(80-100).16 patients had good score(70-79) and 2 patients had fair results(60-69).The mean increase in Knee score was 25.2 .In the osteoarthritis group it was 34 and in rheumatoid group it was 22.

The radiological outcome was reported in many series[40,41,42].The recent one in Journal of Bone and Joint Surgery by PleserM. and Woersdoerfer.O (2005) reported a mechanical-axis-range of 180 ± 3 was achieved in 76.8% of the patients[43]. The tibial component was placed in a 2.1 ± 1.3 varus position .A 0.3 ± 2.7 femoral valgus position was noted.The internal rotation (relative to epicondylar axis) of the femoral component was 2.1 ± 1.5 (0–5.9).[44]

In our short term study the mechanical axis range as measured by the coronal tibio femoral angle averaged 177.5 and a femoral component internal rotation of 1.28° as measured by the Transepicondylar-Posterior condyle component angle.

The patients with ideal placement of the components i.e with mechanical axis in zone C and zone 2 and the rotational alignment accurate(Transepicondylar-Posterior condyle component angle- 0 and 1 degree) had a better knee flexion and knee score[42].

The analysis of 6 knees in which the femoral component was placed at an angle determined by preoperative CT of distal femur shows an increase in knee score and less probability of placing the femoral component in internal rotation.

Our study is comparable to a mid term study done on Fixed bearing and mobile bearing Total Knee Arthroplasty by Attique Vasdev published in Journal of Orthopaedic Surgery 2009;17(2):179-82. The study included 60 cases of Total knee Arthroplasty with a mean age of 63 years.The male to female ratio was 20:40 with a mean follow up of 3 years.The preoperative average range of motion was 88.5° with a Knee society score of 36.5. The postoperative average range of motion was 101° with a Knee society score of 91.7. The survival rate was 96%.

The functional short term analysis was done by a biomechanical study by Professor Dr. Wolfhard Puhl in Journal of Bone and Joint Surgery - British Volume, Vol 91-B, 71-72 which shows no significant functional advantage of mobile bearing over fixed bearing knees.

In a prospective study done Dennis and coworkers, using video fluoroscopy, compared range of motion under non-weight-bearing and weight-bearing conditions among people with normal knees, people who underwent PCR TKA, and those who underwent PS TKA. The reported knee flexion in PS TKA was 112 degrees and they had good stair climbing and near normal gait.

The published results of Young-Hoo Kim, MD, Clin Orthop Relat Res. 2009 February; 467(2): 493–503 reported the postoperative knee score to be 87 and the knee flexion 115+/- 18 degree

The short term study by D. Parsch, M. Krüger, M. T. Moser and F. Geiger International Orthopaedics Heidelberg 1432-5195 (Online) IssueVolume 33, Number 2 / April, 2009 evaluated the outcome of 65 knees and the mean score in these patients were 76 and average knee flexion was 118 degrees.

In our study we noted a similar outcome except for a less postoperative Knee score.

No patients had loosening and osteolysis noted around the femoral and tibial components[45].This was not significant as this is a short term study.

No implant needed to be revised during the period of study[46].There was no incidence of superficial or deep infection[47].

Of the 20 patients 18 cases returned to their premorbid condition.Two patients who where rheumatoid has persistent pain.

SUMMARY AND CONCLUSION

The objective of our study was to evaluate the short term clinical and radiological outcome after fixed bearing Total knee arthroplasty.

The clinical outcome was evaluated by the Knee society knee score.The postoperative assessment was done between 3 months and one year of the procedure.

We concluded that:

- The mean preoperative Knee society score was 50.4, While the mean postoperative score was 75.6 indicative of the overall good short term clinical outcome.
- 2 patients had excellent score(80-100), 16 patients had good score(70-79) and 2 patients had fair results(60-69).
- The average postoperative flexion in the rheumatoid group was 105.4 degrees and in the osteoarthritis group was 115.8 degrees
- Patients with rheumatoid arthritis achieved less postoperative range of flexion compared to the osteoarthritis group.But they achieved more increase in knee score.
- The mechanical axis range as measured by the coronal tibio femoral angle averaged 177.5 and a femoral component internal rotation of 1.28° as measured by the Transepicondylar-Posterior condyle component angle.

- The patients with ideal placement of the components i.e with mechanical axis in zone C and zone 2 and the rotational alignment accurate(Transepicondylar-Posterior condyle component angle- 0 and 1 degree) had a better knee flexion and knee score provided other factors are normal.

- No implant needed to be revised during the period of study.There was no incidence of superficial or deep infection.

- Routine preoperative CT of the distal femur helps in determing the degree of external rotation of the femoral component

- Correct rotational alignment of the femoral component results in a better function postoperatively.

We conclude that the correct positioning of the components both axially and rotationally improves the functional outcome of fixed bearing knee in low demand patients with an excellent short term clinical outcome[48].

Further follow up and evaluation with more number of patients is essential to come out with a definitive conclusion.

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